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Hemodynamic Dimensions as Heuristic Predictor for Epidural Anesthesia Conversion to General Anesthesia During Lower Segment Caesarean Section Surgery

ZafriYusoff[1*] & Associate Professor Dr. Ir Ahmad Faizul bin Shamsudin[2*]

[1] Institut Latihan Kementerian Kesihatan Malaysia Sultan Azlan Shah Perak Malaysia
e-mail:zafriyusoff@yahoo.com

[2]Universiti Sultan Azlan Shah (USAS), Bukit Chandan 33000 Kuala Kangsar, Perak Darul Ridzuan, Malaysia

Abstract

Background

Lumbar epidural anesthesia was considered to be the gold standard in anesthesia practice. It caused some form sympathetic blockade and changed baseline peripheral vascular tone including some dynamic changes. However, failure of epidural anesthesia was a clinical problem together with difficult to predict failure based on clinical parameter and hemodynamic changes

Methods

Parturient undergoing lower segment caesarean section LSCS surgery under epidural anesthesia enrolled in this mono centric study. Parturient were in the range of age 16 - 45 years old with ASA 1, II and II involved in the study The total of 160 parturient (respondents) planned for elective and emergency lower segment caesarean section LSCS surgery obtained from Yamane formula $n = N / (1 + Ne^2)$ calculation with the Universal Convenience Sampling. Clinical observational and interventional methods were applied using a formatted checklist. Data collected were categorized into phenomenological, physiological, and emotional experience dimensions with crossed reference to determine the contributing factors for lumbar epidural anesthesia failure.

Visual analogue pain scores VAPS, Bromage scale and perfusion index PI were used as instrument to assess lumbar epidural anesthesia blockade. After the administration of hyperbaric anesthetic drug into epidural space, hemodynamic changes were recorded every five minutes. Simultaneously, somatosensory, visual analogue pain scores VAPS, Bromage scale were assessed. Statistical analyses with SPSS version 24 were performed using Chi Square, Independent T – Test, ANOVA and Bivariate analysis for numerical variable. Levene's Test for equality of variances assumption was used to check for homogeneity.

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Results

Physiological factors as hemodynamic dimension especially referring to duration of labor ($P < 0.05$) & perfusion index PI ($P < 0.05$) at parameter value of base line 3.99 ± 0.44 contributed to the lumbar epidural anesthesia failure. Elements of emotional experience such as Visual Analogue Pain Score ($P < 0.05$) and Bromage Scale ($P < 0.05$) were considered as a validated tool for assessing the

effectiveness of lumbar epidural anesthesia for parturient mothers. Phenomenological dimensions had no relationship to lumbar epidural anesthesia failure and our failure rate was 3.8% in this study in this study.

Conclusions

Perhaps new heuristics in new Transition Policy Anesthesia Analysis TAPA could be developed for addressing more holistic in determination of lumbar epidural anesthesia failure among parturient undergoing lower segment caesarean section LSCS surgery.

Recommendation

Future direction Technology advances should be used as way to predict epidural failure such as Transcutaneous Electrical Nerve Stimulation (TENS). Ultrasound imaging of the spine could be proposed to facilitate identification of the epidural space and predict difficult spine score, especially in women with abnormal lumbosacral anatomy (scoliosis) and those who were obese.

Keywords - Pulse Oximeter, Perfusion Value Index SpO2, Epidural Failure, Lower Segment Caesarean Section LSCS, Lumbar Epidural Anaesthesia

Introduction

There were some forms of curiosity about lumbar epidural anesthesia occasionally did work which considered as lumbar epidural anesthesia failure. The incidence of epidural anesthesia failure needed to be addressed as parturient expected a very satisfactory analgesia in the contexts of lower segment caesarean section LSCS surgery. Pain was considered the oldest medical problem and the universal physical affliction of mankind. Yet not much understanding had been explored to understand especially in physiological contexts. A question could be thrown here why epidural anesthesia did not work occasionally. Pain was a subjective feeling that could affect physiological wellbeing and emotional experience. It had been addressed as a factor to stimulate the sympathetic nerve system causing to increase Oxygen O_2 consumption in human body.

Epidural anesthesia (epidural blockade) was used very most commonly for procedures involving lower abdomen especially for lower segment caesarean section LSCS surgery. The belief system that initiation of epidural blockade (epidural anesthesia) would resulting pain free and consciousness level maintained. Previous author studied the various reason the possibility of epidural anesthesia converted to general anesthesia. For an example, Hermanides et al (2012) came out with few reasons why epidural anesthesia failure occurred. They listed reasons for epidural anesthesia failure occurred including incorrect primary placement, secondary migration of a catheter after correct placement, and suboptimal dosing of local anesthetic drugs but they did not mention anything about hemodynamic changes that might affect lumbar epidural anesthesia.

Something came into our mind why epidural anesthesia had the tendency to be converted into general anesthesia. Perhaps the current report of epidural anesthesia failure rates for caesarean section delivery should be re examined. The current review was not sufficiently summarizes whether technical factors known to influence epidural anaesthesia failure. On the other hand pharmacologic factor

gave a reason why epidural anesthesia converted into general anesthesia. A report by Robert et al (2009) emphasized primary epidural anesthetics for elective cesarean delivery had a failure rate of 0.21% which considered very nominal..

Shin et al (2016) highlighted in quite detail about epidural anesthesia pertaining to hemodynamic dimension. They gave their opinion that efficacy of regional anesthesia in women in women undergoing lower segment caesarean section LSCS. They discussed about hemodynamic changes and stability including a statement converting into general anaesthesia after failure of epidural anesthesia was 5%. Therefore, a preparation to induce general anesthesia if epidural anesthesia failure occurred considered mandatory. The question here was, did hemodynamic dimension could be considered or as predictor for epidural anesthesia failure?. At the junction there was no clear evidence about hemodynamic changes or instability could affect the successful rate of epidural anesthesia. Apart from that, lower segment caesarean section

For the clinical context, there was no globally-accepted definition of epidural anesthesia failure: this leaded to wide differences in reported failure rates. As such, data analysis by Katircioglu et al describing the 0.35% failure rate of epidural anesthesia for lower segment cesarean section LSCS surgery. Whereas, Halpern et al (2009) stated (n=21, 4.1%) parturient required general anesthesia GA after epidural anesthesia administration. At this particular point, data from the United Kingdom UK reported a similar, high incidence (89%) of intraoperative conversion being to GA. Sen (2016) revealed minimizing hemodynamic changes resulting from sympathetic autonomic blockade (epidural anesthesia) through a case report of Epidural Anesthesia for lower segment caesarean section LSCS surgery among parturient with severe pulmonary hypertension. However, he did not state whether hemodynamic changes could be considered as predictor for epidural failure.

In spite of some percentage of epidural anesthesia failure especially among parturient undergoing lower segment caesarean section, the real caused of lumbar epidural anesthesia failure still hidden. It was so difficult to relate with hemodynamic dimension as causes more towards technical and pharmacological problems. It was also related to the believed that incidence of lumbar epidural failure depended on the institution setting and the level of training duration of anesthetist performing it. Furthermore, it was claimed that lower segment caesarean section LSCS surgery was one of the most common surgical procedure globally. As claimed by Wang (2017) lower segment caesarean section LSCS rates had risen in China within the past 25 years, with specific statement driven by non-medical factors and maternal requests. Universally too, it was so rare to find issue about hemodynamic dimension as predictor to indicate lumbar epidural anesthesia failure.

Material and Methods

This study was conducted in Labor Room Hospital Raja Permaisuri Bainun to evaluate the hemodynamic dimension as an early detection of epidural anesthesia failure for parturient mothers scheduled for lower segment caesarean section LSCS surgery. Parturient mothers planned for elective and emergency LSCS and undergoing epidural anesthesia chosen as samples of this study. The sample size

was calculated based on Yamane formula $n = N / (1 + Ne^2)$ Where n = corrected sample size, N = population size, and e = margin of error (0.05) based on the research condition. The calculated sample size and the power of study was achieved a power of 80% and detected a difference of p-value less than 0.05.The total population of parturient undergoing lower segment caesarean section LSCS during the study period was 271 parturient. Hence the required samples size were 160 parturient calculated using Yamane formula. Lower segment caesarean section LSCS surgery would not been begun until loss of sensation to ethyl chloride spray/pin prick/fine touch with cotton achieved bilaterally to maximum level T7. The parturient would be accepted for this the study if the block did not reach the level T7 within 30 min or with an additional study drug injected and 45 min after the 3rd dose. For this perspective, both successful and epidural anesthesia failure groups were accepted for this study for making a comparative analysis. World Federation of Societies of Anesthesiologists (2001) recommended that height of block suitability for LSCS surgery at T6 - T7. Motor block been assessed bilaterally using the modified Bromage scale: 1 = no paralysis (full flexion of hip, knee and foot), 2 = unable to flex hip (able to flex knee and ankle), 3 = unable to flex knee (able to flex foot only), 4 = unable to flex hip, knee or ankle joint. Motor block assessments will not be made during LSCS surgery.

Sampling of the study was done through wide range of age group of all parturient mothers undergoing epidural anesthesia. We as researchers used combination of clinical observational and interventional methods for parturient mothers undergoing for LSCS and examined achievable of satisfactory level of epidural anesthesia after epidural puncture plus insertion of Tuohy epidural needle and catheter including the injection of drugs used. Parturient mothers were in sitting position and asked to arch their back and remain still while sitting up during insertion of epidural needle through lumbar space. The Universal Convenience Sampling was used to gather a valid representing of the total populations within the time frame of collecting data. The total population of parturient mothers undergone LSCS were 271 within the period of 1st January to 12th July 2017.

Instrumentation

A checking list as an observation proforma for LSCS epidural anesthesia was used to collect the data in exploring factors contribute to the satisfactory level of epidural anesthesia for parturient mothers planned for elective and emergency LSCS. As clinical practice, a pulse oximetry also been used as continuous monitoring plus as predictor to measure values of peripheral capillary oxygen saturation SpO_2 for the epidural anesthesia effectiveness. The perfusion index PI was monitored and recorded at 0, 5, 10, 15, and 20 min intervals after epidural anesthesia commenced. For intra operative monitoring non-invasive blood pressure and mean arterial pressure MAP measurements were done simultaneously with perfusion index PI observation. For additional information the oximetry sensor was attached to the first finger of the left hand on the side where procedure of LSCS surgery was initiated at the right side of parturient. The sensor was connected in order to obtain baseline perfusion index PI, pulse and SpO2 values for peripheral capillary Qxygen saturation.

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Statistics

Statistical analyses were performed using SPSS® version 24.0. Data that collected and computed were represented as mean (± standard deviation) for quantitative variables and percentages for qualitative variables. Distribution of perfusion index PI was subjected to normality test ($P < 0.05$). The point-biserial correlations were used for examining the association between mean perfusion index PI and epidural failure incidence/successful epidural anesthesia using independent T Test. Three variables were Bilateral Somatosensory Block Evaluation, Visual Analogue Scale VAS as pain assessment tool. Bromage Scale tested with Chi Square in relation to epidural failure and successful epidural anesthesia. For the two items Visual Analogue Scale VAS & Bromage Scale scored 0.70 Cronbach's Alpha for the reliability statistic

Results and Discussion

A total of hundred and sixty (n = 160) parturient involved in this study. This was from N = 271 of the total population of parturient undergone epidural anaesthesia during the period of data collection 21st January till 10 of July 2017. The mean age of parturient participated in this study was 28.03 with a standard deviation of ± 5.48. The minimum and maximum ages were 16 and 45 years respectively. Parturient with successful epidural anaesthesia reported to have mean age of 27.96 ± 5.47 where as those with epidural failure that needed conversion to general anesthesia was 29.83 ± 6.11.

At this particular incident, it was observed also that mean parity was 0.86 ± 1.22. On the other hand, successful epidural group had mean parity of 0.76 ± 1.17 and epidural conversion group to general anesthesia was 1.00 ± 1.10. There was no concrete reference data in analyzing the effect of parity on the successful or epidural anesthesia failure. Muppuri et al (2012) studied for factors of risk potential independent epidurals failure among 502 parturients for labor. In their study they indicated that n = 171 (34.1%) were nulliparous and n = 331 (65.9%) were primiparous. It was not so cleared whether parity affected the successful epidural anaesthesia. For this particular aspect, we found our respondents n = 89 (55.6) were nulliparous, n = 32 (20.0%) were primiparous and n = 39, (24.4%) were multiparous.

The mean epidural needle inserted was 4.45 ± 0.75 cm with minimum of 4.00 and maximum of 10.00 cm for hundred and sixty parturient involved in this study. The mean epidural needle insertion for successful group was 4.45 ± 0.76 and for epidural conversion group 4.50 ± 0.45 cm. The difference of mean epidural needle insertion was 1.11% (0.05 cm difference). Shiroyama et. al concluded that the distance of epidural needle from skin to epidural space for most Japanese parturient women were 3.00 – 4.00 cm at the L1-L2 inter space. In our study we did not attempt L1-L2 inter space but mostly at L3 – L4 inter space (n=87, 54.4%) with mean depth of 4.49 ± 0.92 in cm (Refer Figure 1 and Table 1).

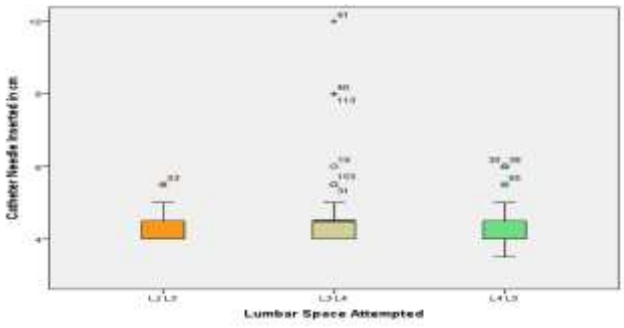

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Figure 1: Lumbar Space Attempted with Cross Reference to Mean Catheter Needle Insertion

Table 1: Mean for Contextual Predictors for successful and failure group of epidural – Independent T -Test - Phenomenological Dimension

Contextual - Mean	Successful epidural (n = 154, 96.2%) Mean ± SD	Epidural Conversion to GA (n = 6, 3.8%) Mean ± SD	Mean Difference and 95% confidence interval	*P*-Value
Mean maternal age	27.96 ± 5.47	29.83 ± 6.11	1.87(-0.64 to 6.38)	0.41
Parity	0.76 ± 1.17	1.00 ± 1.10	0.24(-0.71 to 1.20)	0.62
Epidural needle depth to skin (cm)	4.45 ± 0.76	4.50 ± 0.45	0.05(-0.57 to 0.67)	0.87

Only three (n = 3, 1.9%) cases of parturient having bony obstruction from successful epidural group and non from conversion group (Refer Table 2). There were all together 20 cases that having difficulty in threading epidural needle. It comprised of eighteen (18) cases, (11.2%) from successful epidural group and two (2) cases, 1.3%) from conversion group. Therefore it brought together 140 cases without difficulty in threading needle catheter whereby (n = 136, 85.0%) from successful group and (n = 4, 2.5%) from conversion group (Refer Table 2).

Table 2: Phenomenological Dimension For Successful and Failure Group of Epidural – Chi Square Test of Phenomenological Dimension

Technical Predictors	Successful epidural (n=154, 96.2%)	Epidural Conversion to GA (n= 6, 3.8%)	*P*-value
Bony Obstruction			
a. Yes	3 (1.9%)	0 (0.0%)	0.73
b. N0	151 (94.3%)	6 (3.8%)	
Total	154 (96.2%)	6 (3.8%)	
Difficulty in Threading Needle Catheter			
a. Yes	18 (11.2%)	2 (1.3%)	0.12
b. N0	136 (85.0%)	4 (2.5%)	
Total	154 (96.2%)	6 (3.8%)	

From physiological perspective, it was found that 50 (31.3%) parturient were induced for labor. They consisted of (n = 48, 30.0%) from successful epidural and (n = 2, 1.3%) from conversion of epidural to general anesthesia. The number of parturient undergone epidural anesthesia without induction of labour was 110 (68.7%) whereby 106 cases (66.2%) was observed from successful epidural group epidural and four (4) cases (2.5%) from epidural conversion to general anesthesia group were not induced for labor (Refer Table 3).

The total number of bloody tap occurred (n = 8, 5.0%) in successful group of epidural anesthesia as compared to nil (n = 0, 0.0%) from epidural anesthesia failure group. Therefore, the total number of non bloody tap incident was 152 (95.0%) and it was only occurred in successful group of epidural anesthesia (Refer Table 3).

Table 3: Physiological Dimension for successful and failure group of epidural - Chi Square Test

Contextual Predictors	Numbers of Successful Epidural Anaesthesia (n, %)	Conversion of Epidural Anesthesia to General Aanaesthesia (n, %)	Asymptotic Significance *p* values (2-sided)
Induction of Labour			
a. Yes	48 (30.0%)	2 (1.3%)	0.91
b. No	106 (66.2%)	4 (2.5%)	
Total	154 (96.2%)	6 (3.8%)	
Bloody Tap			
a. Yes	8 (5.0%)	0 (0.0%)	0.57
b. No	146 (91.2%)	6 (3.8%)	

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Total	154 (96.2%)	6 (3.8%)

From our finding, the mean duration for labour among successful group of lumbar epidural anaesthesia was 688.86 ± 256.32 in minutes and for lumbar epidural anaesthesia failure group was 885.0 ± 97.11 in minutes (Levenes Test for Equality of Variances = 0.01). In other word, it could be said that the successful group of lumbar epidural anesthesia slightly longer as compared to lumbar epidural anesthesia failure group. It was significant when P value < 0.05 showing duration of labor influenced the effectiveness of lumbar epidural anesthesia (Refer Table 4) .

Table 4: Mean Duration of Labor Analysis - Phenomenological Dimension

	GA Conversion	n	Mean	Std. Deviation	*p* values (2-sided)
Duration of Labour in Minutes	YES	6	885.00	97.11	0.00
	NO	154	688.86	256.32	

A study carried out by Kathuria & Sapkal (2016) latent phase prolongation for nullipara was 21 hours and for multipara was about 12 hours (42.9%) difference. It was very curious such big difference between our finding and Kathuria & Sapkal (2016) finding. We calculated that those parturient with nullipara status took duration of 731.7 minutes (12.2 hours) and those with multipara 585.0 minutes (9.8 hours). The difference was 12.2 – 9.8 = 2.4 hours which equivalent to 19.7%. Figure 2 displayed variation of mean duration of labor in minutes versus parity.

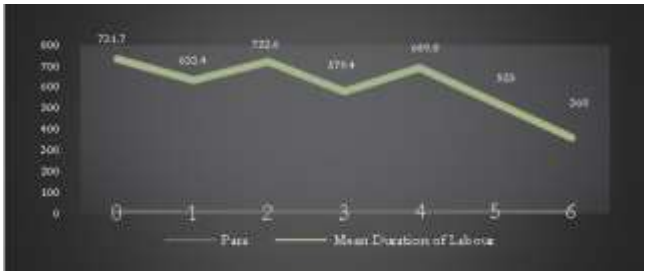

Figure 2: Mean Duration of Labor Based on Parity

Mean maternal blood lost was slightly higher volume measured in milliliter 520.09 ± 55.46 (mean ± SD) in successful epidural group as compared to epidural failure group 500.00 ± 53.19 (mean ± SD) with P value more than 0.05 as P = 0.39 (Refer Figure 3). For this particular issue, Aksoy et al (2015) claimed general anesthesia was related to higher risk of blood lost. In this present study, failure epidural anesthesia group that required general anesthesia for caesarean section having blood lost less than successful epidural anesthesia group. This finding revealed a very well controlled of intra operative hemorrhage by obstetricians while performing lower segment caesarean section LSCS surgery. It was an interesting finding to see less bleeding among parturient who already been administered with epidural drugs and converted to general anesthesia with less bleeding as compared to lumbar epidural anesthesia group. At this junction Heesen et al. (2013) found a significant difference in the amount of blood loss associated with epidural anesthesia compared with that associated with general anesthesia GA.

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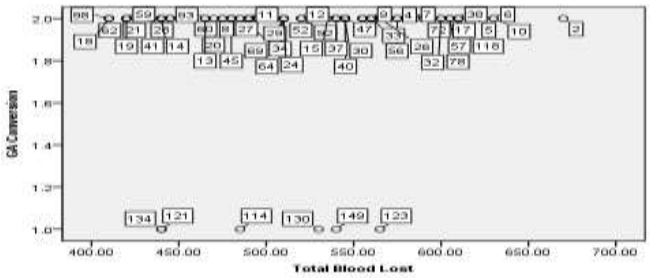

Figure 3: Comparison of Blood Lost Between Epidural Conversion and Non Epidural Conversion - Physiological Dimension

Mean maternal Oxygen saturation SpO_2 was almost equivalent in successful epidural group with 98.30 ± 0.25 (mean ± SD) when compared to epidural failure with value of 98.28 ± 0.29 (mean ± SD). These values were represented by the percentage showing that each red blood cell was made up of more 98.0% oxygenated and less than 2.0% non-oxygenated hemoglobin. The normal SpO2 values were recognized in between 95.0% and 100%. Therefore, both groups were having a good blood oxygenation and preventing phenomenon of hypoxia (Refer Figure 4).

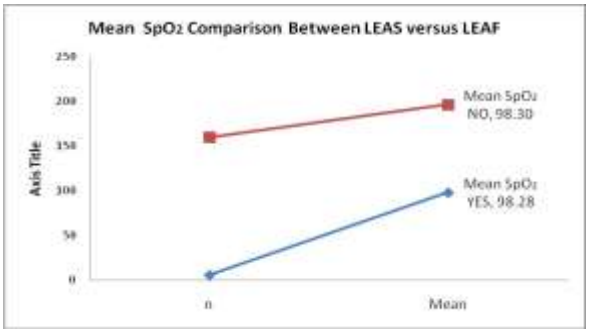

Figure 4: Mean SpO_2 Comparison between Lumbar Epidural Anesthesia Successful versus Between Lumbar Epidural Anesthesia Failure - Physiological Dimension

Mean maternal initial Blood Pressure Systolic (S)) / Diastolic (D) at the level of 131.53 (S) / 80.25 mmHg (D) ± 16.55 (S) / 9.95 mmHg (D) for the successful lumbar epidural anesthesia group (Refer Figure 5). While the mean maternal initial Blood Pressure Systolic (S)) / Diastolic (D) for the failed lumbar epidural anesthesia group that needed conversion to general anesthesia was recorded as 134.17 (S) / 84.83 (D) ± 10.48 (S) / 9.96 (D) ± 10.48 (S) / 9.96 (D) with P value = 0.70 (Systolic) / P = 0.27 (Diastolic). The Hemodynamic dimension for the initial noninvasive blood pressure was very suitable for both lumbar epidural anesthesia and general anesthesia.

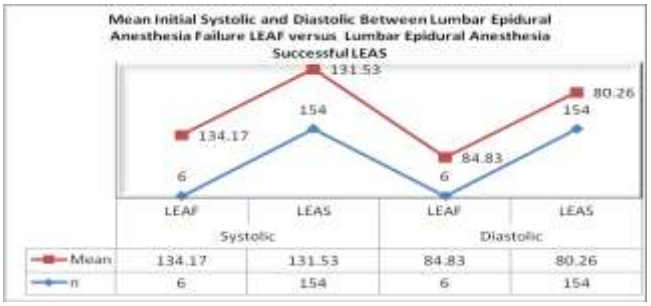

Figure 5: Mean Initial Blood Pressure Comparison Between Lumbar Epidural Anesthesia Successful versus Between Lumbar Epidural Anesthesia Failure - Physiological Dimension

Parturient undergoing lower segment caesarean section LSCS surgery might experience physiologic effect of lumbar epidural anesthesia such as hypotension due to blockade of the sympathetic nervous system making arterial and venous vasodilation. If not controlled the effect might be with subsequent hypovolemia problem. We decided to use arterial mean pressure to mean arterial pressure as medium to assess hemodynamic changes to assess the effect of epidural anesthesia and general anesthesia (lumbar epidural anesthesia failure).

Pertaining to maternal mean arterial pressure as hemodynamic dimension (Refer Figure 6) it was found that

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97.35 ± 10.92 which slightly lower for successful epidural anesthesia group when compared to epidural failure anesthesia group as recorded at the level of 101.28 ± 8.18 with P value of 0.39. These suggested the lumbar epidural anesthesia resulting more peripheral vasodilatation including conferred more sympathetic blockade and thus reduction in peripheral resistance as compared to general anesthesia group. It was very difficult to dictate physiological difference reduction in peripheral resistance for both groups.

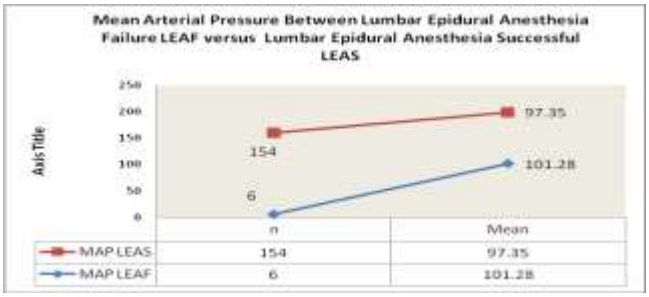

Figure 6: Mean Arterial Pressure Comparison Between Lumbar Epidural Anesthesia Successful versus Between Lumbar Epidural Anesthesia Failure - Physiological Dimension

Mean maternal initial base pulse rate as recorded per minute 84.77 ± 10.50 for successful epidural anesthesia group and for epidural anesthesia group 87.33 ± 11.36 with P = 0.56. Therefore, there was no significant difference between in terms of initial pulse rate between lumbar epidural anesthesia and general anesthesia conversion group. The hemodynamic dimension of initial pulse rate did not influenced the total blood lost as p > 0.05, r = 0.02 (Refer Figure 7).

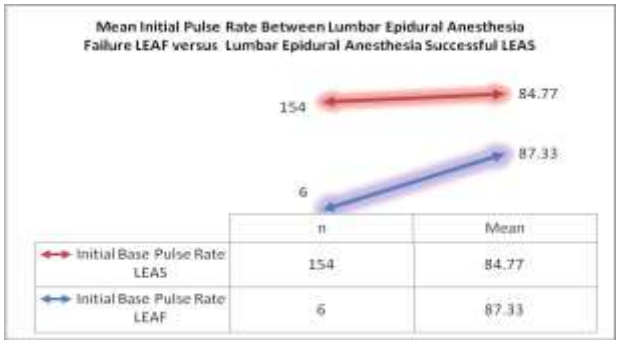

Figure 7: Mean Initial Pulse Rate per Minute Comparison between Lumbar Epidural Anesthesia Successful versus Between Lumbar Epidural Anesthesia Failure - Physiological Dimension

Regarding to mean maternal hemoglobin Hbgm %, it was recorded at the level of 12.13 ± 0.65 for successful epidural anesthesia group and 11.88 ± 1.00 for epidural failure anesthesia group with P value 0.37 (Refer Figure 8).

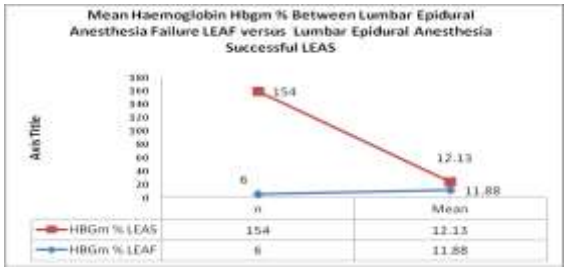

Figure 8: Mean Hemoglobin Hbgm% Comparison between Lumbar Epidural Anesthesia Successful versus Between Lumbar Epidural Anesthesia Failure - Phenomenological Dimension

As displayed in Table 5, initial pulse rate did not influence blood lost in the context of physiological dimension. Based on Table 6 there was no correlation between hemoglobin that triggered blood lost for both group lumbar epidural anesthesia success and lumbar epidural anesthesia failure when p > 0.05 with r = 0.06. Beside that both mean parturient temperature and operating theatre temperature with blood lost had no correlation at all

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in the perspective of physiological dimension & phenomenological dimension (Refer Table 7).

Table 5: Correlation of Initial Pulse Rate with Blood Lost - Physiological Dimension

Total Blood Lost			
Spearman's rho	Initial Base	r	*P* value
	Pulse Rate	0.02	0.76

Table 6: Correlation of Hbgm% With Blood Lost - Phenomenological Dimension & Physiological Dimension

Total Blood Lost			
		r	P value
Hbgm %	Pearson Correlation	0.06	0.48.

Table 7: Correlation of Mean Parturient Temperature and Operating Theatre Temperature With Blood Lost - Physiological Dimension & Phenomenological Dimension

		Mean Parturient Temperature	Operating Theatre Temperature
Total Blood Lost	Pearson Correlation r	0.06	-0.02
	Sig. (2-tailed)	0.48	0.74

On the aspect of mean parturient temperature at the level 36.52 ± 0.98 for successful epidural anesthesia group LEAS and at the level of 36.07 ± 1.44 for the epidural anesthesia failure LEAF group with P value of 0.27 (Refer Figure 9). There was no significant difference in terms of mean parturient temperature when *P*= 0.28, P > 0.05 with *t* statistic of -1.09 (158 df) as illustrated in Figure 9.

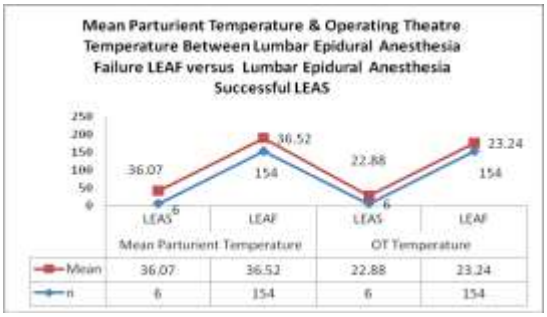

Figure 9: Mean Parturient Temperature & Operating Theatre Temperature Comparison Between Lumbar Epidural Anesthesia Successful versus Between Lumbar Epidural Anesthesia Failure

Mean maternal Perfusion Index PI as shown in Figure 10 proven to be higher in successful lumbar epidural anesthesia group 4.65 ± 0.10 (mean ± SD). Maternal mean Perfusion Index PI proven to be lower in lumbar epidural anesthesia failure group that needed conversion to general anesthesia 3.99 ± 0.44 (mean ± SD) with P value less than 0.05 (P = 0.00). Looking at the maternal mean perfusion index, Ginosar et al (2009) discovered that pulse oximeter perfusion index PI provided an earlier and clearer indication of sympathectomy following epidural anesthesia. We had similar opinion with Ginosar et al (2009) as traditional believe epidural anesthesia could induce vasodilatation resulting of relaxation of the muscles during epidural anesthesia intra operatively. The mean difference of perfusion index PI between successful lumbar epidural anesthesia group and lumbar epidural anesthesia failure group (4.65 – 3.99 = 0.66/4.65) which was equivalent to 14.2 %. It was a novelty finding in this research area. Thus, perfusion index PI provided an earlier, more objective, and more sensitive indicator to assess the early onset of lumbar epidural anesthesia effectiveness/failure for parturient undergoing lower segment caesarean section LSCS surgery.

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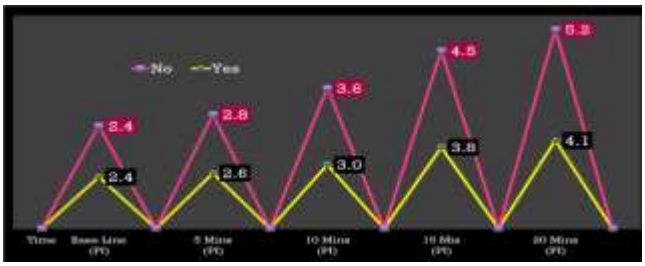

Figure 10: Perfusion Index Trend between Lumbar Epidural Anesthesia Successful versus Between Lumbar Epidural Anesthesia Failure Group - Physiological Dimension

The method of bilateral somatosensory block evaluation two minutes interval applied to check for the assessment of effectiveness of epidural anesthesia (Refer Figure 11. Pin prick was the common technique applied as such for the successful epidural anesthesia n = 77 (48.1%) and for the epidural anesthesia failure n = 6 (3.8%). At this particular issue, seventy five parturient (n = 75, 46.9%) was not applied with any technique to assess the effectiveness of epidural anaesthesia. Ethyl Chloride Spray n = 1 (0.6%) and fine touch with cotton = 1 (0.6%) were applied for the successful group of epidural anesthesia. Ethyl Chloride Spray and fine touch with cotton were not applied for the epidural anesthesia failure group. There was no correlation of using pin prick, Ethyl Chloride Spray and fine touch with cotton or without any testing for the bilateral somatosensory block evaluation as P value more than 0.05 (P = 0.12) in determination of successful or failure of epidural anesthesia.

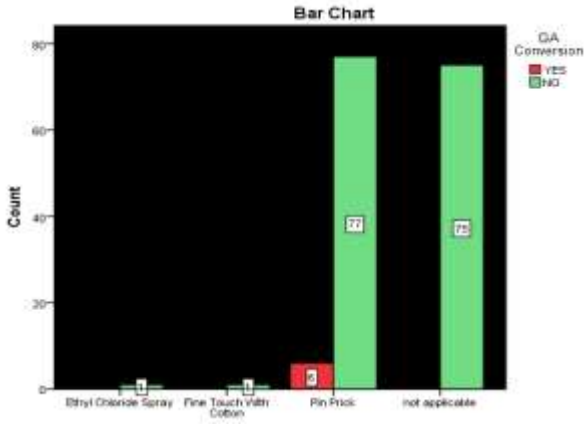

Figure 11: The Method Of Bilateral Somatosensory Block Evaluation Two Minutes Interval - Emotional Experience

Pain as one of elements of determination of clinical manifestation of lumbar epidural anesthesia failure was evaluated by using a 0-10 cm Visual Analogue Scale VAS (Refer Figure 12). Majority of parturient n = 136 (85.0%) in successful group epidural anesthesia attained Scale 1 for VAS. It was followed by attaining Scale 2 of VAS (n = 18, 11.2%) for successful group epidural anesthesia and nil of parturient attained Scale 3 for this successful epidural anesthesia group. For epidural anesthesia failure group, one parturient (0.6%) attained Scale 1, one parturient (0.6%) attained Scale 2 and four parturient (2.6%) attained Scale 3. It was revealed that quite significant Visual Analogue Scale as P = 0.00 that might influence the successful or failure of epidural anesthesia,

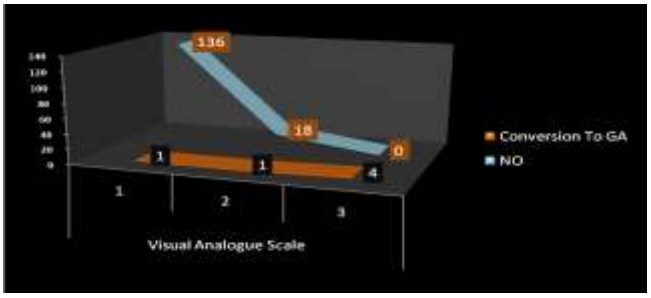

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Figure 12: Analysis of Visual Analogue Scale VAS between Lumbar Epidural Anesthesia Successful Group and Lumbar Epidural Anesthesia Failure Group - Emotional Experience

Bromage score based on four grade criteria degree of block were analysed for right and left lower limb in this study (Refer Figure 13). For the right lower limb, number of parturient in successful group of epidural anaesthesia(n = 94, 58.7%) achieved free movement of leg and foot and n = 2 (1.3%) for the failed epidural anaesthesia group. Second criteria that was just able to flex knee with free movement of right foot n = 10 (6.2%) achieved this criteria for the successful group of epidural anaesthesia and n = 2 (1.3%) achieved this criteria for the group of failure epidural anaesthesia. The third criteria of Bromage scale for the right lower limb, it was found n = 4 (2.5%) achieved the level of unable to flex knee but with free movement of foot for the successful group of epidural anaesthesia and n = 1 (0.6%) for the epidural anaesthesia failure group. The fourth criteria of Bromage scale for the right lower limb, the number of parturient in successful group of epidural anaesthesia n = 46 (28.8%) achieved unable to move leg or foot and n = 1 (0.6%) in epidural anaesthesia failure group achieved unable to move leg or foot.

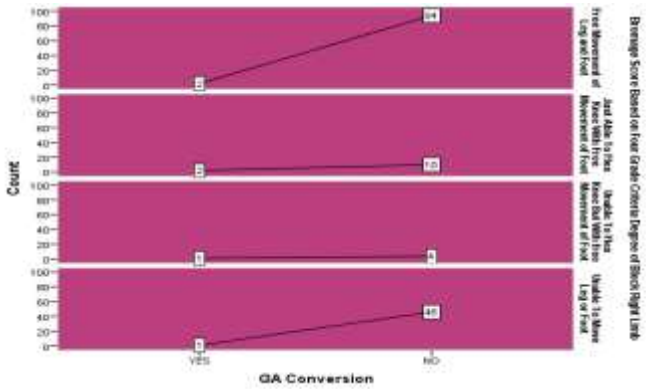

Figure 13: Analysis of Bromage Scale for Right Limb - Emotional Experience

For the left lower limb (Refer Figure 14), number of parturient in successful group of epidural anesthesia (n = 93, 58.0%) achieved free movement of leg and foot and n = 2 (1.3%) for the failed epidural anesthesia group. Second criteria that was just able to flex knee with free movement of left foot n = 10 (6.3%) achieved this criteria for the successful group of epidural anesthesia and n = 2 (1.3%) achieved this criteria for the group of failure epidural anesthesia. The third criteria of Bromage scale for the right lower limb, it was found n = 5 (3.1%) achieved the level of unable to flex knee but with free movement of foot for the successful group of epidural anaesthesia and n = 1 (0.6%) for the epidural anaesthesia failure group. The fourth criteria of Bromage scale for the right lower limb, the number of parturient in successful group of epidural anaesthesia n = 46 (28.8%) achieved unable to move leg or foot and n = 1 (0.6%) in epidural anesthesia failure group achieved unable to move leg or foot. The P value of 0.02 Bromage score based on four grade criteria degree of block right limb among parturient demonstrated significant difference. Similarly the P value of 0.03 Bromage score based on four grade criteria degree of block left limb among parturient demonstrated significant difference.

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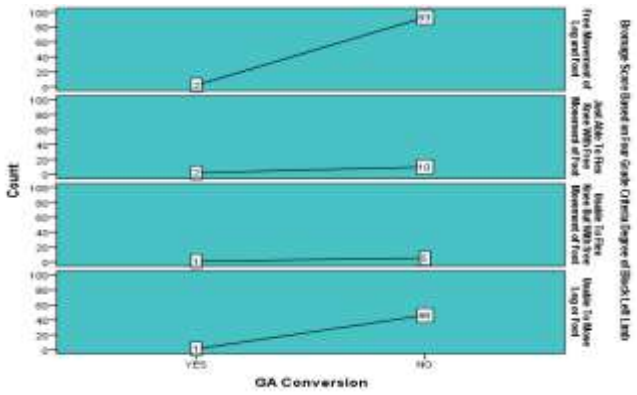

Figure 14: Analysis of Bromage Scale for Left Limb - Emotional Experience

Mean temperature of parturient and operating theatre ambient were also assessed between two groups of parturient based on similar time interval of perfusion index time in five minutes interval (Refer Figure 15). Perfusion index PI intervals of were 0, 5, 10 and 20 min following epidural anesthesia. The purpose was to check the effect of lumbar epidural anesthesia among parturient undergoing lower segment caesarean section LSCS surgery over time in relation to temperature as well as to analyze any indicator of temperature influencing perfusion index PI. Mean parturient temperature different between two groups 36.52 – 36.07 = 0.45 which was 1.2% difference. Mean operating theatre temperature different between two groups 23.24 - 22.88 = 0.36 which was 1.6% difference.

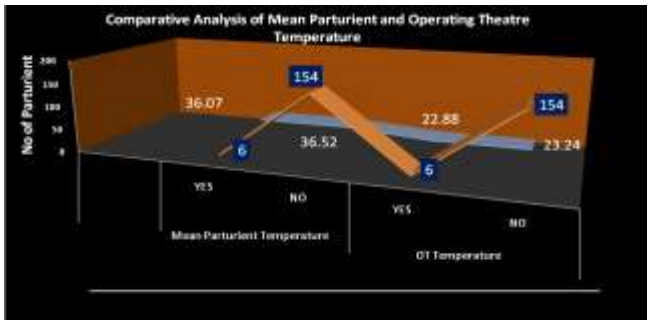

Figure 15: Analysis of Parturient and Operating Theatre Temperature - Phenomenological Dimension

Table 8: Bivariate Analysis of Correlation Mean Perfusion Index with Mean Parturient and Operating Theatre Temperature - Physiological Dimension & Phenomenological Dimension

Mean perfusion index PI		
	r	p value
Mean parturient temperature	0.02	0.79
Mean operating theatre temperature	-0.01	0.88

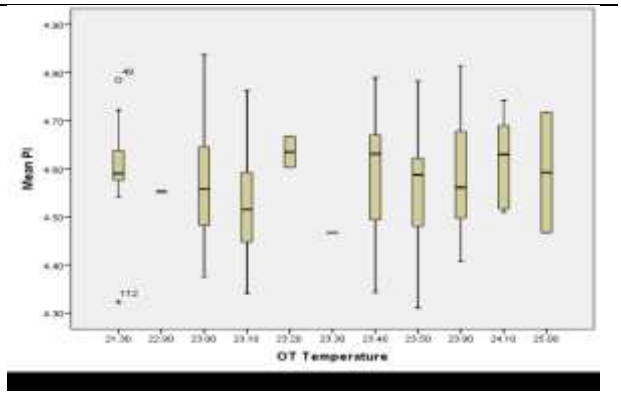

Figure 16: Pattern of Physiological Dimension Perfusion Index PI Crossed Reference to Operating Theatre Temperature

If referred to Table 8, mean parturient and operating theatre temperature did not influence the outcome of perfusion reading. Individually $p > 0.05$ with r = 0.02 with no relationship at all for mean parturient temperature brought effect to perfusion index outcome. Similarly with mean operating theatre temperature when $p > 0.05$ with r = -0.01 displayed negative relationship with outcome of perfusion index. In Figure 16 illustrated the distribution of

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operating theatre temperature with cross reference mean perfusion index.

In our result, temperature did not affect Oxygen saturation as $P = 0.36$ with r = - 0.07 were not correlated at all. The analogy of solubility of Oxygen decreasing as temperature increasing needed further analysis. The temperature of parturient ranging from 33.2º – 37.6º C. Descriptively, it was quite contradicted with the analogy solubility of Oxygen O_2 decreasing as temperature increasing. Our finding demonstrated that at the value of 37.6º C mean parturient temperature (the highest mean), the oxygen saturation SpO_2 at the value of 98.9% (Refer Table 9). The lowest mean of temperature among parturient (33.2º C) reflected the lower mean SpO_2 with the value of 97.2%. Therefore in our finding the higher mean temperature of parturient resulted in the increasing of solubility of Oxygen in the blood circulation.

Table 9: Mean Parturient Temperature versus Mean Oxygen Saturation SpO_2 - Physiological Dimension & Phenomenological Dimension

	n	Min	Max	Mean	Spearman's r	p
Mean SpO2		97.2	98.9	98.3	- 0.1	0.36
Mean Parturient Temperature ºC	160	33.2	37.6	36.5		

Table 10: Oxygen saturation SpO_2 - Physiological Dimension

Parturient Temperature	Pulse Oximeter Oxygen Saturation SpO2							
	97.2	97.8	98.0	98.2	98.3	98.6	98.9	Total
33.2	0	2	0	3	3	4	0	12
36.0	0	1	0	2	1	0	1	5
36.1	0	0	0	3	0	1	0	4
36.2	0	0	0	2	2	1	0	5
36.3	0	0	0	1	0	0	0	1
36.4	0	1	0	2	1	1	0	5
36.5	0	0	0	2	0	2	0	4
36.6	0	0	0	1	2	0	0	3
36.7	0	0	1	14	10	13	0	38
36.8	0	4	0	12	10	16	0	42
36.9	1	4	0	3	3	7	0	18
37.1	0	1	0	7	4	2	0	14
37.6	0	1	0	6	2	0	0	9
Total	1	14	1	58	38	47	1	160

Lima et al (2002) claimed that changes in peripheral perfusion index and changes in core-to-toe temperature difference correlated significantly (r = 0.52, p <. 001). Speights (2017) in his clinical studies in adult and pediatric patients demonstrated that an increase in perfusion index PI was clearly an early indicator of general and epidural anesthesia which occurred before the onset of the anesthetic effect due to peripheral vasodilatation. Masimo Corporation (2016) stressed that detection of a spike in perfusion index PI was a sign to the successful onset of anesthesia. According to Speights (2017), conversely, no increase in perfusion index PI in a patient given under anesthesia that might be an early warning of anesthetic failure. Therefore, as an objective indicator of pain levels in patients, the perfusion index PI had been used to determine proper management of pain, especially in patients unable to communicate their discomfort to the anesthesiologist.

The controversies about the factors determining the epidural anesthesia failure were not fully understood as might be due to inappropriate methodology or sample sizes. Based on Chia et al (2015), they carried out a retrospective cohort study on epidural anesthesia for hundred and eight parturient (n = 108) undergoing lower segment cesarean

section LSCS surgery with the illustration of n = 11 (11.1%) failure rate. These percentage of failure rate came from various variation as indicated by Samina Ismail et al (2015) from their observational study revealed that epidural anesthesia failure to achieve surgical anesthesia in 6.8% (n = 12/176). Another study done by Hermanides et al (2012) claimed that epidural anesthesia & analgesia failure reached up to 30.0% in clinical practice. However in our study, it was found that the failure rate only n = 6, (3.8%) from the total number of parturient (n = 160) undergone lower segment caesarean section LSCS surgery. This finding was very contrary with suggestion by The Royal College of Anesthetists (2012) that less than 3.0% of epidural anesthesia cases should need conversion to general anesthesia as only 0.8% exceeded.

At the same times, the controversies about the factors determining the epidural anesthesia failure covered very limited issues as what previous studies displayed. In fact, Chia et al (2015) could not prove demographic characteristics influenced the epidural anaesthesia failure. Our study also could not prove demographic characteristics influenced the epidural anesthesia failure. As what found by Chia et al (2015) mean age (years) were 31.4 ± 4.12 with P value of 0.69. They did not analysed mean age for successful epidural and epidural anesthesia failure as what done by us. In our data mean maternal age were 27.96 ± 5.47 for successful epidural and 29.83 ± 6.11 for epidural failure with P value of 0.41. From our descriptive statistic, it was found that mean age of our samples were 28.03 ± 5.48 slight younger than mean age group from Chia et al (2015) samples. Again, it was so difficult to make assumption that age influenced the epidural anesthesia failure.

The overall perception from us was lower segment caesarean section LSCS surgery an extremely safe operation. Most of the serious complications associated with lower segment cesarean section LSCS surgery were not due to the operation itself but from blood lost as been belief. In fact hypotension could occur due the blood lost during caesarean section which could affect peripheral vascular tone. A study done by Toyama et al (2013) about perfusion index derived from a pulse oximeter and the incidence of hypotension during spinal anaesthesia for caesarean section delivery. They revealed baseline perfusion index PI correlated with the degree of decreases in systolic and mean arterial pressure due to sympathetic blockade and decreased cardiac output due to blood pooling in blocked areas of the body. Our study did not focus on the incidence of hypotension and we were focused on the incidence of blood lost. Basically in our study, the bleeding incidences were well controlled. A study done by Ashraf & Hisham (2006) pointed that obstetricians gave 539.0 ml as mean estimation of blood lost. Our total mean estimation blood lost for 160 parturient was 510.0 ml with the difference of 29.0 ml equivalent to 5.4%.

It was recorded that systolic blood pressure/diastolic blood pressure 134.17/84.83 mmHg slightly higher as compared to successful epidural group 131.53/80.25 mmHg in this study. The physiologic changes of pregnancy, including an initial gradual increase in cardiac output, followed by the development of increasing aortocaval compression in the third trimester, as well as co morbidities such as preeclampsia, have generated considerable research into maternal hemodynamic (Dyer and James, 2008). Both of them studied the effects of epidural analgesia (anesthesia) in labor. They suggested that heart rate and noninvasive

blood pressure measurement, as well as communication with the awakening parturient during regional (epidural) anesthesia, remain the most important monitors for the obstetric anesthesiologist.

Simuyu (2015) also confirmed the conversion rate among patients who lost more than 1 litre of blood was significantly (Z-test p-value < 0.00) higher than the conversion rates among patients who lost blood between 0.5 and 1.0 litre. This was probably due to complications like post-partum hemorrhage that resulted in longer surgeries hence the conversions in this group. Catarci et al (2016) study lacked of data on mean arterial pressure MAP whereas in our setting we also focused on mean arterial pressure reading. Our mean arterial pressure slightly lowered for successful epidural group as compared to epidural group failure (97.35 ± 10.92 versus 101.28 ± 8.18). The higher reading of mean arterial pressure MAP might be due to pain sensation. Sen et al (2016) studied on epidural anesthesia specifically referred to safe option for cesarean section in parturient with severe pulmonary hypertension. They illustrated following caesarean section surgery with blood pressure BP 112/58 mmHg, MAP 73 mmHg, PR 110/min, SpO_2 100%. This was considered good finding to substantiate with our research data.

The method of bilateral somatosensory block evaluation was done through pin prick, fine touch with cotton and Ethyl Chloride Spray. These were the common practice globally. Pain block in obstetric epidural anesthesia was usually accompanied by relatively persistent retention of motor power; however, the reason for this was not entirely clear. Pin prick were the most popular used to determine the height of sensory block. Conversion among parturient n = 6 in this study came from the group tested through pin prick.

The conversion rate of lumbar epidural anesthesia shifted to general anesthesia GA according to Bromage Scale (Right Limb) was; Scale 1 (n = 2, 1.3%), Scale 2 (n – 2, 1.3%), Scale 3 (0.6%) and Scale 4 (n = 1, 0.6%). The conversion rates varied significantly (Chi-square test P-value < 0.05) with motor grading. The conversion rate of lumbar epidural anesthesia shifted to general anesthesia GA according to Bromage Scale (Left Limb) was; Scale 1 (n = 2, 1.3%), Scale 2 (n – 2, 1.3%), Scale 3 (0.6%) and Scale 4 (n = 1, 0.6%). The conversion rate varied significantly (Chi-square test P-value < 0.05) with motor grading. Kimuyu (2015) conversion rate according to Bromage Scale was; grade 0 (0%), grade 1 (40%), scale 2 (7.7%) and scale 3 (3.8%). He persuaded the conversion rates varied significantly (Chi-square test p-value < .001) with motor grading. One thing that we missed to understand his finding was whether analysis done for both limbs.

The final discussion in this study was the conceptual framework could be fitted as new heuristics in new Transition Policy Anesthesia Analysis TAPA can be developed for bridging the gaps in in determination of failure for epidural anesthesia especially for lower segment caesarean section LSCS surgery. Only two elements of physiological factors mean duration of labor and maternal mean perfusion index PI at parameter of 3.99 ± 0.44 contributed to epidural failures. In terms of emotional experiences, we detected three elements contributed to epidural failure such as visual analogue pain score VAPS, Bromage scale, restlessness and patchy block contributed to epidural failure. It was good to say that we managed to calculate mean perfusion index PI at parameter of 3.99 ± 0.44 contributed to epidural failures among parturients

undergoing caesarean section when international data still not published.

Pulse Oximetry Modalities became predictor for failed epidural among parturient mothers undergoing lower segment caesarean section LSCS surgery. Our hypothesis that there was relation between failed and successful epidural pertaining to perfusion index PI value among parturient mothers undergoing lower segment caesarean section LSCS accepted.

Conclusion

There was still a gap in relation to epidural study on rate of failure. It was an expectation that low rates of conversion of labour epidural anaesthesia to general anaesthesia GA for caesarean section occured. Phenomenological data did not contribute to the epidural failure. Certain components of physiological data such as duration of labour contributing to epidural failure and perfusion index showed positive correlation contributing as predictor for epidural effectiveness. While conversion of epidural anaesthesia to general anaesthesia GA implied an inadequate labouranaesthesia and reliable assessment of adequacy of surgical anaesthesia was necessary. It was hoped that perfusion index PI monitoring would warrant further exploration for other clinical anaesthesia applications where information on peripheral perfusion or circulatory status would be useful. The traditional predictor psychosocial/emotional experience of visual analogue scale VAS still existed as predictor for epidural failure together with assessment using Bromage scale. It was a valid reason to belief that duration of labour, restlessness and patchy block became heuristic of indicator as well as predictor for epidural anaesthesia failure.

Potential future applications and research utilization findings included of the success and epidural anaesthesia failure based on that perfusion index PI values at parameter of 3.99 ± 0.44 as a value for predictive model also as new heuristic model. Some technical factors also expected to increase the primary and secondary success rate. Perfusion Index was considered as a technical tool available and had sufficient accuracy and predictability with a growing evidence-base to justify evaluating sympathetic tone or responsiveness in clinical anaesthesia practice. There was still a gap there at 23.2% for epidural failure when Hermanides et al (2012) described 27.0% for lumbar epidural and our study came out with the small rate of 3.8% among parturients undergoing LSCS. Therefore, this could be used asnew heuristics in new a Transition Policy Anaesthesia Analysis TAPA for bridging the gaps in determination of failure for epidural anaesthesia especially for lower segment caesarean section LSCS.

Recommendation

Future direction Technologic advances should be used as way to predict epidural failure. Transcutaneous Electrical Nerve Stimulation (TENS) should be used rather than using pin prick and fine touch with cotton for epidural effectiveness testing. Ultrasound imaging of the spine had recently been proposed to facilitate identification of the epidural space. It should also to include prediction of difficult spine score, especially in women with abnormal lumbosacral anatomy (scoliosis) and those who were obese which associated with pregnancy. There for we would like to propose perfusion index PI values derived from pulse oximeter to be used as a parameter in determination of epidural failure among LSCS parturient mothers.

Limitation of the study

We could not have nerve stimulator something like Transcutaneous Electrical Nerve Stimulation (TENS) and ultrasound guided regional anesthesia techniques in order to reduce migration epidural needle during administration of anesthetic drugs for lower segment caesarean section LCSC surgery. It was supposed to reduce the risk of lumbar epidural anesthesia failure and increase the benefits of this kind of anesthesia (lumbar epidural anesthesia). The most concern was the element restraints on upper left extremity which might cause interference with blood flow.

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